**Estimation of Combining Ability In 10x10 Diallel Crosses Of Bread Wheat Grown Under Normal Irrigation and Salinity Stress Treatment for Some**

**Morphological Physiological Traits**

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**Abstract**

A10x10 half diallel cross were made in 2018/2019 season. Each of parents and their 45 F1 crosses were evaluated under two locations (Ras Sudr and Moshtohor) during 2019/2020 season for some physiological traits. Highly significant genotypes, for genotype and its partitioning (parent, crosses and Parent *vs* crosses) and both types of combining ability mean squares (MS) were obtained for all studied traits under salinity stress , normal and across locations. Meanwhile, significant G x L, parent x L and cross x L were significant for all studied trails except peduncle leaf. Interaction between GCA or SCA and location MS were significant for all studied traits. the ratio between GCA/ SCA were more than unity for all traits except, flag leaf angle in salinity stress, normal condition and combined analysis, as well as relative water content in normal condition and combined analysis. P2 (Shandwel 1) exhibited significant positive ĝi effects for flag leaf area ,peduncle leaf and relative water content in both and cross location and total chlorophyll in Ras-sudr location ,indicating that (Shandwel 1)could be considered as a good combiner for this trails. The most desirable inter and intra allelic interactions were presented by P3 x P4 for flag leaf angle, P3 x P10 for flag leaf area; P7 x P8 for peduncle leaf; P1 x P10 for relative water content and P2 x P5 for total chlorophyll exhibited significant positive  effects.

**Key words*:*** *combining ability, drought stress, GCA, heterosis, ,SCA and Wheat*

**Introduction**

Salinity stress is one of the major factors responsible for less yield and restricting economic utilization of land resources both in arid and semi-arid regions of the World (El Ameen *et al*. 2020). Also, Salinity stress is a major environmental challenge that limits the productivity of crop production worldwide (Oyiga *et al*.2016). More than 800 Mha of land are affected by salinity, which is equivalent to more than 6% often world’s total land (Mickelbart *et al.*2005). Hence, efforts to improve the salt tolerance of plants are of immense importance for sustainable agriculture and may also significantly improve crop yield (Goyal *et al.*2016)

The diallel cross designs are frequently used in plant breeding research to obtain information about genetic properties of parental lines or estimates of general (GCA), specific (SCA) combining ability and heritability **(Baker, 1978; EL- Maghraby *et al*., 2005; Iqbal *et al.*, 2007, Afiah *et al*. 2019 and El-Fahdawy *et al.* 2019)**. In addition, the diallel cross technique was reported to provide early information on the genetic behavior of these attributes in the first generation **(Chowdhry *et al.*, 1992; Topal *et al*., 2004 and El-Hosary *et al*. 2019 a).** Diallel analysis technique is the choice of providing such detailed genetic information for selecting breeding materials that show great promise for success **(Lonnquit and Gardner, 1961)**.

Combining ability describes the breeding value of parental lines to produce hybrids. GCA refers to the average performance of a parent in hybrid combinations and SCA is the performance of a parent relatively better or worse than expected on the basis of the average performance of the other parents involved **(Sprague and Tatum, 1942; and Griffing, 1956)**. Combining ability analysis helps in the identification of parents with high GCA and parental combinations with high SCA. Based on combining ability analysis of different characters, higher SCA values refer to dominance gene effects and higher GCA effects indicate a greater role of additive gene effects controlling the characters. If both the GCA and SCA values are not significant, epistatic gene effects may play an important role in the genetic of characters **Sprague and Tatum, (1942), Hussain *et al*. (2020) and El-Safy et al. (2020).**

The estimation of additive and non-additive gene action through this technique could be useful in determining the possibility of commercial exploitation of heterosis and isolation of pure lines among the progenies of the desirable hybrids **(Stuber, 1994)**. The diallel genetic design and its various modifications have been used by breeders to estimate the potential of populations for intrapopulational improvement and the usefulness of parents in interpopulational breeding programs, and to select inbred lines in hybrid development programs. The best-known methods for diallelic analysis are those developed by **(Hayman, 1954)**, both exclusively for homozygous parents, that by **(Griffing, 1956)**, for circulate diallel cross, that by **(Gardner and Eberhart, 1966)**, of these, the Griffing and Gardner and Eberhart methods are doubtless the most frequently applied.

**The main objectives of the present investigation were to:** induce genetic variability by hybridization, evaluation and selection for the best genotypes of wheat compared with the parents under Moshtohor (Normal water irrigation) and Ras Suder (Saline water irrigation) for important morphological characters.

**Materials and Methods**

This investigation was carried out at two locations the first one was Ras-suder .Desert Research Center (DRC) and the second location was Moshtohor, Faculty of Agriculture, Banha University during the two successive seasons 2017/2018 and 2018/2019. The mechanical and chemical analysis of the two studied experimental soils at Ras Suder .Agricultural Experiment Farm and Moshtohor Research station are in tables (1 and 2). Ten genotypes of bread wheat were used in this study. These parent were selected on bases of yield ability and of desirable plant aspects. The plant materials were selected with wide range of diversity for several trails. The names, source and pedigree of these materials are presented in table 3.

In 2017/2018 growing season, grain from each of the parental varieties or lines were sown at two various planting dates in order to overcome the differences in time of flowering. During this season, all parental combinations without reciprocal were made among the ten parents giving a total of forty-five F1 crosses.

**Field experiments**

In 2018/2019 the ten parents and their forty-five possible F1 crosses were sown on 24th Nov.2019 at the first location (Ras Sudr) and 25th Nov .2019 at the second location (Moshtohor Faculty of Agriculture) .The first experiment represented saline soil using saline irrigation water Table 1 and 2, and the second one was under-normal condition .

Each experiment was designed in a randomized complete block design with three replications .Each plot consisted of one row ,three meters long with 20 cm between rows and plants within row 15 cm apart allowing a total of 20 plant per plot.

Each of Flag leaf angle, Flag leaf area (cm2), Peduncle leaf,

( Relative water content (R.W.C) and total chlorophyll content measured by )(chlorophyll meter SPAD520), **(Barrs and Weatherly 1962)**were recorded as mean of five individual guarded plants/plot chosen at random from each genotype in each experiment.

**Table 1.** Mechanical properties of the soil in the experimental farm of Ras Sudr and moshtohor Agricultural Research Stations analysis.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Texture** | **Clay**  **%** | **Silt**  **%** | **Fine**  **sand %** | **Coarse**  **Sand%** | **Depth (cm)** |
| **Ras Sudr Agricultural Research Station** | | | | | |
| Sandy loam | 15.33 | 16.48 | 45.49 | 22.6 | O\_15 |
| Sandy loam | 17.10 | 18.96 | 28.40 | 35.20 | 15\_30 |
| **Moshtohor Agricultural Research Station** | | | | | |
| Clay | 51.98 | 13.85 | 26.91 | 7.26 | O\_15 |
| Clay | 53.17 | 12.60 | 27.64 | 6.59 | 15\_30 |

**Table 2.** Soil chemical analysis of the soil in the experimental farm of Ras Sudr and moshtohor Agricultural Research Stations analysis and water analysis of Ras Sudr station**.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Soluble anions(mg/100g)** | | | | **Soluble castion(mg/100g)** | | | | **Caco3** | **E.Ce.ds/m** | **pH** | **Depth (cm)** |
| **SO4--** | **Cl-** | **Hco3** | **co3-** | **K+** | **Mg+** | **Ca++** | **Na+** |
| **Ras Sudr Agricultural Research Station** | | | | | | | | | | | |
| 25.2 | 43.8 | 10.85 | ……. | 5.62 | 10.86 | 21.21 | 48.04 | 45.62 | 8.54 | 7.39 | 0-15 |
| 19.8 | 44.95 | 11.6 | …… | 6.23 | 10.80 | 15.19 | 43.24 | 48.34 | 7.84 | 7.71 | 15-30 |
| **Moshtohor Agricultural Research Station** | | | | | | | | | | | |
| 2.58 | 0.57 | 1.25 | …… | 0.16 | 0.23 | 0.9 | 0.81 | 2.3 | 0.18 | 7.8 | 0-15 |
| 3.6 | 0.61 | 1.25 | ……. | 0.21 | 0.28 | 0.9 | 0.77 | 3.30 | 2.00 | 7.6 | 15-30 |
| **Water analysis in Ras Sudr Agricultural Research Station** | | | | | | | | | | | |
| 8.2 | 19.7 | 11.1 |  | 0.5 | 7.3 | 9.1 | 22.1 | --- | 4.01 | 7.3 | Ras -sudr |

**Table 3.** The name pedigree and source of the parental varieties and lines.

|  |  |  |  |
| --- | --- | --- | --- |
| Pedigree | Source | Entry name | NO |
| BOW"S"/KVZ"S"//7C/SER182/3/GIZA 168/SAKHA61. GM7892-2GM-1GM-2GM-1GM-0GM | Egypt | Gemiza 11 | 1 |
| Site / Mo /4/ Nac / Th.Ac // 3\* Pvn /3/ Mirlo / Buc  CMSS93B00567S-72Y-010M-010Y-010M-3Y-0M-0THY-0SH | Egypt | Shandwel 1 | 2 |
| MIL/BUC//Seri  CM93046-8M-0Y-0M-2Y-0B | Egypt | G 168 | 3 |
| S 92/TR 810328 S8871-1S-2S-1S-0S | Egypt | Sakha 93 | 4 |
| OTUS/3/SARA/THB//VEE (CMSS97YOO227 S-5Y-010M-010Y- 010M-2Y – 1M-0Y- OGM) | Egypt | Gemiza 12 | 5 |
| OASIS / SKAUZ // 4\*BCN /3/ 2\*PASTOR CMSS00Y01881T-050M-030Y-030M-030WGY-33M-0Y-0S | Egypt | Misr 1 | 6 |
| MILAN \ S87125 \\ BABAX | CIMMYT | L 125 | 7 |
| MILAN \ S7137\\ Hall //(Ne700011) | CIMMYT | L 137 | 8 |
|  | Egypt | Bulk37\_8 | 9 |
|  | Egypt | Bread43 | 10 |

**Statisical analysis:**

The data of the two experiments were subjected to proper statistical analysis of variance according to **Snedecor and Cochran (1967)**. The effects of genotypes were assumed to be fixed; a one tail was used to test the significance of difference sources of variation. When the differences between genotypes reached the significant level, further appropriate analysis was carried out. Combined analysis of the two experiments was carried out whenever homogeneity of variance was detected. The combined analysis was conducted for the data of the two experiments according to **Cochran and Cox (1957).** Heterosis relative to mid and better parents were also determined for individual crosses according to **Paschal and Wilcox (1975)**

General and specific combining ability estimates (GCA and SCA) were obtained by employing Griffing’s diallel cross analysis **(1956)** designated as method 2 model I.

**Results And Discussion**

The analysis of variance for all studied traits under salinity (location 1) and normal irrigation (location 2) and, across locations is presented in Table 4. Mean squares for location were significant for mention traits revealing that, there was difference between the studied locations.

Highly significant genotypes mean squares were obtained for all morphological and physiological studied traits under both and cross locations. These results indicate that genetic diversity among parents were found. Meanwhile, genotypes x location mean squares were significant for mention traits except, peduncle leaf revealing that the behavior of genotypes response defiantly from one location to another. However, genotypes x location mean squares were in-significant for peduncle leaf indicating that this genotype responds similarly the two types of water supplies (salinity and normal irrigation).

Results in Table 4 indicate that mean squares due to parents were significant for all studied traits under both and across locations. These results indicate wide diversity among studied parents.

Crosses mean squares were significant for physiological traits, its indicating wide diversity among crosses. Meanwhile, significant

genotype x L, parents x L and crosses x L were significant for all studied trails except, peduncle leaf, indicating that, these genotypes behaved somewhat differently from location to another. For the other traits, insignificant interactions were obtained, reflecting that these genotypes responded similarly to locations changes.

**Table (4):** Mean squares for flag leaf angle, flag leaf area and peduncle leaf R. W.C, total chlorophyll and peduncle leaf at both and cross location

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S.O.V.** | **d.f.** | **Flag leaf angle** **(°)** | **Flag leaf area (cm2)** | **Peduncle leaf(cm2)** | **Relative Water Content** | **Total chlorophyll (spad)** |
| **L1 (Ras sidr)** | | | | | | |
| Rep/L | 2 | 2.78 | 2.84 | 15.21\*\* | 1.13 | 5.56 |
| Genotypes (G) | 54 | 44.62\*\* | 89.46\*\* | 13.24\*\* | 229.60\*\* | 14.04\*\* |
| Parent (Par.) | 9 | 49.54\*\* | 29.94\*\* | 16.56\*\* | 395.43\*\* | 27.39\*\* |
| Cross (Cr.) | 44 | 44.62\*\* | 103.44\*\* | 12.86\*\* | 195.88\*\* | 11.40\*\* |
| Par.vs.cr. | 1 | 0.11 | 10.31 | 0.02 | 220.54\*\* | 10.17 |
| Error | 108 | 4.05 | 2.88 | 2.6 | 5.63 | 4.68 |
| GCA | 9 | 14.67\*\* | 69.61\*\* | 8.54\*\* | 82.35\*\* | 10.77\*\* |
| SCA | 45 | 14.91\*\* | 21.86\*\* | 3.59\*\* | 75.37\*\* | 3.46\*\* |
| Error | 108 | 1.35 | 0.96 | 0.87 | 1.88 | 1.56 |
| GCA/SCA |  | 0.98 | 3.18 | 2.38 | 1.09 | 3.11 |
| L2 (moshtohor) | | | | | | |
| Rep/L | 2 | 5.83 | 7.24 | 0.85 | 1.29 | 0.79 |
| Genotypes (G) | 54 | 36.94\*\* | 98.27\*\* | 15.81\*\* | 208.29\*\* | 24.25\*\* |
| Parent (Par.) | 9 | 13.36\*\* | 23.67\*\* | 18.30\*\* | 108.08\*\* | 20.25\*\* |
| Cross (Cr.) | 44 | 42.44\*\* | 115.02\*\* | 15.65\*\* | 233.18\*\* | 25.23\*\* |
| Par.vs.cr. | 1 | 7.3 | 32.54\*\* | 0.25 | 15.17 | 17.05 |
| Error | 108 | 3.12 | 3.99 | 3.77 | 3.92 | 6.27 |
| GCA | 9 | 11.93\*\* | 70.22\*\* | 11.94\*\* | 44.81\*\* | 9.09\*\* |
| SCA | 45 | 12.39\*\* | 25.26\*\* | 3.93\*\* | 74.36\*\* | 7.88\*\* |
| Error | 108 | 1.04 | 1.33 | 1.26 | 1.31 | 2.09 |
| GCA/SCA |  | 0.96 | 2.78 | 3.04 | 0.6 | 1.15 |
| Comb and cross location | | | | | | |
| Location (L) | 1 | 670.02\* | 1237.95\* | 174.87\* | 51.06\* | 5580.97\* |
| Rep/L | 4 | 4.31 | 5.04 | 8.03\* | 1.21 | 3.18 |
| Genotypes (G) | 54 | 59.25\*\* | 181.64\*\* | 25.61\*\* | 221.41\*\* | 19.33\*\* |
| Parent (Par.) | 9 | 28.49\*\* | 49.63\*\* | 33.50\*\* | 204.78\*\* | 21.51\*\* |
| Cross (Cr.) | 44 | 66.83\*\* | 211.87\*\* | 24.57\*\* | 225.85\*\* | 18.72\*\* |
| Par.vs.cr. | 1 | 2.82 | 39.74\* | 0.22 | 175.69\* | 26.77\* |
| G x L | 54 | 22.31\*\* | 6.09\*\* | 3.44 | 216.48\*\* | 18.96\*\* |
| par. x L | 9 | 34.41\*\* | 3.98 | 1.36 | 298.74\*\* | 26.14\*\* |
| Cr. x L | 44 | 20.24\*\* | 6.58\*\* | 3.94 | 203.21\*\* | 17.91\*\* |
| Par.vs.cr. x L | 1 | 4.59 | 3.11 | 0.06 | 60.02\* | 0.44 |
| Error | 216 | 3.58 | 3.43 | 3.19 | 4.78 | 5.48 |
| GCA | 9 | 16.30\*\* | 138.48\*\* | 18.95\*\* | 61.95\*\* | 11.53\*\* |
| SCA | 45 | 20.44\*\* | 44.96\*\* | 6.45\*\* | 76.17\*\* | 5.43\*\* |
| GCA x L | 9 | 10.30\*\* | 1.35 | 1.53 | 65.20\*\* | 8.33\*\* |
| SCA x L | 45 | 6.86\*\* | 2.17\*\* | 1.07 | 73.55\*\* | 5.92\*\* |
| Error | 216 | 1.19 | 1.14 | 1.06 | 1.59 | 1.83 |
| GCA/SCA |  | 0.8 | 3.08 | 2.94 | 0.81 | 2.12 |
| GCA x L/GCA |  | 0.63 | 0.01 | 0.08 | 1.05 | 0.72 |
| SCA x L/SCA |  | 0.34 | 0.05 | 0.17 | 0.97 | 1.09 |

\*,\*\* L1 and L2 refer to, significant at 0.5 , 0.01 levels of probability,Rassidr location and Moshtohor, respectively

The mean performances of the ten parental varieties or lines and parental combinations are presented in Table 5.

It is clear that crosses p7 x p10 , p1 x p7 ,p3 x p4 and p4 x p5 behave as the Eric leaf of plant , when it had the lowest mean values for flag leaf area .These crosses may be used to increase the density of plants per unit area .

For leaf area, the crosses p2 x p6 , p2 x p4 ,p2 x p5, p2 x p8 and p3 xp10 gave the highest values for this trait .

For peduncle leaf , the three parental No p10 (Bread 43) ,p3 (G168) and p4(Saka 93) and the nine crosses p2 x p5 , p2 x p6 ,p4 x p8, p4x p9 , p4 x p10 p6 x p9 , p6 x p10 ,p7 x p8and p7 x p10 had the highest mean values in the combined analysis. The crosses p1 x p9 , p1 x p4 and p1 x p6 showed the lowest mean values for this trait .

Concerning to R.W.C the three crosses p1 x p3 , p1 x p10 and p2 x p3

had the highest mean values .These hybrids were the highest tolerance to stress condition .However, the parent p10 (Bread 34)gave the lowest one.

For total chlorophyll content, the three crosses p1 x p6 , p1x p7 and p8 x p10 gave the highest values . Also the parents p6 , p7, p8 ,and p10 and the crosses p1 x p5 , p1 x p8 ,p1 x p4, p1 x p10 , p2 x p4 ,p3 x p6 , p4x p6 ,p4 x p8, p4x p10 ,p5 x p6 ,p5 x p7 , p5 x p10 ,p6 x p7, p6x p8 and p9 x p10 gave the highest values without significant than the highest mean value of cross p8 x p10 (52.87).The cross p1 x p4 gave the lowest one.

**Combining ability:**

Analysis of variance for combining ability at each location and combined data for all studied traits are shown in Table 4. Mean squares of both GCA and SCA were significant for all studied traits in salinity stress (Rassidr location) and normal (Moshotohor location) as well as combined across locations. However, the ratio between GCA/ SCA were more than unity for all traits except flag leaf angle in both and cross locations, relative water content in normal condition and combined cross locations.

Mean squares due to the interaction between GCA or SCA and locations were significant for all traits, indicating that the magnitude of additive and additive by additive and non-additive types of gene action varied from one location to another. On the contrary, insignificant mean squares due to the interaction between GCA and locations were detected for leaf area and peduncle leaf indicating that additive and additive x additive types of gene action was more stable for both traits. **El-Shal (2011) , Zare-kohan and Heidari (2012), Farshadfar *et al.* (2013)and Gomaa *et al.* (2014)**.

The interaction between SCA and locations were significant for flag leaf angle, flag leaf area, relative water content, and total chlorophyll indicating that ( non-additive types of) gene action varied from location to another**.** Insignificant mean squares due to the interaction between SCA and location were detected for peduncle leaf indicating that non additive type of gene action for this trait was more stable in different location.

The ratio between GCA x location /GCA was much higher than that of SCA x location /SCA for flag leaf angle and relative water content, indicating that additive effects were much more influenced by location than non-additive genetic one. For the exceptional cases, the ratio between

SCA x L /SCA was much higher than of GCA x L/GCA indicating that non additive type of gene action were more influenced than additive effects. Such results are in harmony with those obtained by **Gilbert (1958).**

**Table 5.** Mean performance for flag leaf angle, flag leaf area and peduncle leaf R. W.C, total chlorophyll and peduncle leaf at both and cross locations

| Genotype | **Flag leaf angle(°)** | | | **Flag leaf area(cm2)** | | | **Peduncle leaf(cm2)** | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **L1** | **L2** | **Comb.** | **L1** | **L2** | **Comb.** | **L1** | **L2** | **Comb.** |
| P1 (Gemiza 11) | 33.43 | 31.57 | 32.50 | 54.18 | 58.71 | 56.45 | 9.83 | 11.73 | 10.78 |
| P2 (Shandwel1) | 32.17 | 33.33 | 32.75 | 59.11 | 62.38 | 60.75 | 13.17 | 13.53 | 13.35 |
| P3 (G 168) | 35.00 | 37.43 | 36.22 | 52.66 | 56.90 | 54.78 | 13.17 | 16.63 | 14.90 |
| P4 (Sakha 93) | 35.33 | 35.53 | 35.43 | 51.88 | 55.17 | 53.52 | 12.83 | 13.33 | 13.08 |
| P5 ( Gemiza 12) | 30.17 | 32.87 | 31.52 | 60.20 | 60.83 | 60.51 | 11.33 | 13.73 | 12.53 |
| P69( Misr 1) | 25.00 | 36.73 | 30.87 | 52.31 | 58.44 | 55.37 | 9.80 | 11.40 | 10.60 |
| P7 (L 125) | 24.00 | 36.37 | 30.18 | 53.50 | 56.62 | 55.06 | 10.67 | 11.40 | 11.03 |
| P8 (L 137) | 34.87 | 37.43 | 36.15 | 51.57 | 56.25 | 53.91 | 10.23 | 11.63 | 10.93 |
| P9 ( Bulk37\_8) | 32.67 | 33.07 | 32.87 | 56.64 | 60.18 | 58.41 | 16.17 | 17.10 | 16.63 |
| P10 ( Bread43) | 33.67 | 35.47 | 34.57 | 51.89 | 53.07 | 52.48 | 15.87 | 17.70 | 16.78 |
| 1x2 | 32.67 | 37.73 | 35.20 | 52.81 | 54.53 | 53.67 | 12.33 | 10.77 | 11.55 |
| 1x3 | 34.83 | 35.37 | 35.10 | 52.55 | 55.18 | 53.86 | 11.73 | 12.49 | 12.11 |
| 1x4 | 36.56 | 33.90 | 35.23 | 51.81 | 54.88 | 53.34 | 10.00 | 9.63 | 9.82 |
| 1x5 | 35.83 | 26.97 | 31.40 | 53.60 | 56.67 | 55.13 | 10.00 | 10.37 | 10.18 |
| 1x6 | 33.66 | 37.76 | 35.71 | 41.71 | 48.19 | 44.95 | 9.55 | 10.30 | 9.93 |
| 1x7 | 24.17 | 25.63 | 24.90 | 44.20 | 46.29 | 45.25 | 9.50 | 11.20 | 10.35 |
| 1x8 | 34.33 | 38.20 | 36.27 | 43.13 | 44.62 | 43.88 | 9.83 | 11.30 | 10.57 |
| 1x9 | 25.47 | 28.27 | 26.87 | 55.21 | 58.87 | 57.04 | 8.47 | 10.60 | 9.53 |
| 1x10 | 32.33 | 32.67 | 32.50 | 56.61 | 59.72 | 58.17 | 10.10 | 16.30 | 13.20 |
| 2x3 | 36.00 | 37.77 | 36.88 | 61.78 | 63.81 | 62.80 | 13.00 | 13.60 | 13.30 |
| 2x4 | 34.83 | 36.77 | 35.80 | 63.39 | 69.44 | 66.42 | 13.00 | 14.80 | 13.90 |
| 2x5 | 34.00 | 37.33 | 35.67 | 63.65 | 67.16 | 65.40 | 16.33 | 17.30 | 16.82 |
| 2x6 | 36.10 | 34.63 | 35.37 | 64.16 | 70.35 | 67.25 | 15.53 | 16.57 | 16.05 |
| 2x7 | 31.67 | 36.77 | 34.22 | 65.55 | 65.52 | 65.53 | 12.17 | 12.53 | 12.35 |
| 2x8 | 30.50 | 31.17 | 30.83 | 62.17 | 69.49 | 65.83 | 12.43 | 12.93 | 12.68 |
| 2x9 | 32.00 | 29.10 | 30.55 | 61.76 | 64.81 | 63.29 | 14.50 | 16.20 | 15.35 |
| 2x10 | 30.50 | 37.43 | 33.97 | 53.03 | 56.12 | 54.57 | 13.00 | 16.87 | 14.93 |
| 3x4 | 24.00 | 28.20 | 26.10 | 51.88 | 57.12 | 54.50 | 12.67 | 11.30 | 11.98 |
| 3x5 | 35.83 | 37.77 | 36.80 | 55.12 | 60.81 | 57.96 | 11.83 | 14.40 | 13.12 |
| 3x6 | 24.33 | 32.23 | 28.28 | 52.50 | 53.77 | 53.14 | 11.23 | 12.30 | 11.77 |
| 3x7 | 36.00 | 36.20 | 36.10 | 51.57 | 59.58 | 55.58 | 15.50 | 12.83 | 14.17 |
| 3x8 | 33.50 | 37.43 | 35.47 | 55.33 | 60.81 | 58.07 | 10.83 | 13.20 | 12.02 |
| 3x9 | 29.67 | 34.63 | 32.15 | 58.37 | 64.30 | 61.33 | 12.67 | 13.43 | 13.05 |
| 3x10 | 35.67 | 36.73 | 36.20 | 62.58 | 69.13 | 65.86 | 10.63 | 11.20 | 10.92 |
| 4x5 | 24.83 | 35.53 | 30.18 | 54.50 | 55.56 | 55.03 | 14.17 | 16.20 | 15.18 |
| 4x6 | 34.30 | 34.53 | 34.42 | 53.31 | 58.71 | 56.01 | 12.37 | 13.60 | 12.98 |
| 4x7 | 31.67 | 34.97 | 33.32 | 46.57 | 51.82 | 49.19 | 10.83 | 13.43 | 12.13 |
| 4x8 | 32.17 | 32.00 | 32.08 | 61.63 | 63.03 | 62.33 | 16.33 | 17.30 | 16.82 |
| 4x9 | 35.83 | 36.93 | 36.38 | 56.75 | 64.78 | 60.77 | 15.00 | 17.10 | 16.05 |
| 4x10 | 29.83 | 31.60 | 30.72 | 55.49 | 59.03 | 57.26 | 13.50 | 16.87 | 15.18 |
| 5x6 | 31.00 | 38.30 | 34.65 | 61.76 | 62.78 | 62.27 | 13.17 | 13.63 | 13.40 |
| 5x7 | 31.87 | 39.00 | 35.43 | 51.86 | 53.85 | 52.86 | 12.70 | 13.10 | 12.90 |
| 5x8 | 31.67 | 35.60 | 33.63 | 57.87 | 63.00 | 60.43 | 11.60 | 15.47 | 13.53 |
| 5x9 | 26.67 | 26.37 | 26.52 | 56.89 | 59.44 | 58.16 | 12.17 | 16.07 | 14.12 |
| 5x10 | 30.50 | 36.97 | 33.73 | 53.08 | 60.41 | 56.75 | 11.70 | 15.73 | 13.72 |
| 6x7 | 34.50 | 34.43 | 34.47 | 53.29 | 58.23 | 55.76 | 11.23 | 11.70 | 11.47 |
| 6x8 | 34.17 | 36.53 | 35.35 | 51.56 | 52.56 | 52.06 | 12.17 | 12.63 | 12.40 |
| 6x9 | 25.03 | 36.07 | 30.55 | 59.40 | 62.78 | 61.09 | 13.47 | 14.87 | 14.17 |
| 6x10 | 26.67 | 34.50 | 30.58 | 42.29 | 46.73 | 44.51 | 15.17 | 15.30 | 15.23 |
| 7x8 | 35.83 | 35.70 | 35.77 | 57.60 | 62.83 | 60.21 | 16.13 | 16.63 | 16.38 |
| 7x9 | 33.33 | 32.87 | 33.10 | 51.87 | 58.33 | 55.10 | 9.50 | 12.30 | 10.90 |
| 7x10 | 24.00 | 24.87 | 24.43 | 60.88 | 63.19 | 62.04 | 14.00 | 17.20 | 15.60 |
| 8x9 | 32.67 | 36.60 | 34.63 | 53.88 | 57.93 | 55.90 | 8.50 | 11.87 | 10.18 |
| 8x10 | 32.17 | 37.93 | 35.05 | 50.76 | 53.73 | 52.24 | 10.83 | 11.60 | 11.22 |
| 9x10 | 33.17 | 37.60 | 35.38 | 51.15 | 55.42 | 53.28 | 11.00 | 12.30 | 11.65 |
| LSD 5% | 3.22 | 2.83 | 3.03 | 2.71 | 3.20 | 2.96 | 2.58 | 3.11 | 2.86 |
| LSD 1% | 4.22 | 3.70 | 3.97 | 3.56 | 4.19 | 3.89 | 3.39 | 4.07 | 3.75 |

**Table (5): Cont.**

| Genotype | **Relative water content** | | | **Total chlorophyll** | | |
| --- | --- | --- | --- | --- | --- | --- |
| **L1** | **L2** | **Comb.** | **L1** | **L2** | **Comb.** |
| P1 (Gemiza 11) | 82.59 | 61.78 | 72.19 | 56.33 | 39.87 | 48.10 |
| P2 (Shandwel1) | 77.39 | 72.13 | 74.76 | 55.23 | 41.50 | 48.37 |
| P3 (G 168) | 73.12 | 65.27 | 69.20 | 51.30 | 45.30 | 48.30 |
| P4 (Sakha 93) | 80.18 | 64.02 | 72.10 | 49.27 | 42.50 | 45.88 |
| P5 ( Gemiza 12) | 62.76 | 74.49 | 68.63 | 47.87 | 42.70 | 45.28 |
| P6 ( Misr 1) | 62.18 | 77.08 | 69.63 | 55.70 | 44.57 | 50.13 |
| P7 (L125) | 72.79 | 75.48 | 74.14 | 54.83 | 48.07 | 51.45 |
| P8 (L 137) | 72.94 | 78.95 | 75.94 | 54.63 | 45.53 | 50.08 |
| P9 ( Bulk37\_8) | 66.56 | 66.71 | 66.63 | 49.97 | 46.23 | 48.10 |
| P10 ( Bread43) | 43.13 | 67.95 | 55.54 | 51.87 | 46.93 | 49.40 |
| 1x2 | 73.06 | 62.84 | 67.95 | 55.73 | 41.53 | 48.63 |
| 1x3 | 80.72 | 82.78 | 81.75 | 50.37 | 45.80 | 48.08 |
| 1x4 | 72.28 | 82.75 | 77.52 | 45.80 | 41.93 | 43.87 |
| 1x5 | 85.82 | 55.85 | 70.83 | 52.40 | 48.40 | 50.40 |
| 1x6 | 67.87 | 65.86 | 66.86 | 55.87 | 48.27 | 52.07 |
| 1x7 | 58.18 | 65.14 | 61.66 | 57.47 | 47.53 | 52.50 |
| 1x8 | 75.99 | 70.95 | 73.47 | 51.23 | 52.73 | 51.98 |
| 1x9 | 64.41 | 82.18 | 73.30 | 54.10 | 46.53 | 50.32 |
| 1x10 | 84.36 | 80.77 | 82.57 | 53.77 | 47.33 | 50.55 |
| 2x3 | 83.88 | 85.93 | 84.90 | 54.50 | 45.60 | 50.05 |
| 2x4 | 83.86 | 71.86 | 77.86 | 52.80 | 40.87 | 46.83 |
| 2x5 | 76.96 | 62.02 | 69.49 | 53.57 | 49.53 | 51.55 |
| 2x6 | 74.03 | 67.33 | 70.68 | 55.33 | 42.23 | 48.78 |
| 2x7 | 66.20 | 67.55 | 66.87 | 53.33 | 41.73 | 47.53 |
| 2x8 | 77.86 | 74.20 | 76.03 | 53.97 | 45.30 | 49.63 |
| 2x9 | 76.27 | 81.97 | 79.12 | 54.63 | 40.83 | 47.73 |
| 2x10 | 77.25 | 75.20 | 76.23 | 54.37 | 43.57 | 48.97 |
| 3x4 | 72.96 | 62.01 | 67.49 | 51.57 | 46.60 | 49.08 |
| 3x5 | 66.99 | 66.71 | 66.85 | 53.63 | 44.13 | 48.88 |
| 3x6 | 64.95 | 83.68 | 74.31 | 53.57 | 48.57 | 51.07 |
| 3x7 | 66.65 | 47.95 | 57.30 | 52.23 | 42.77 | 47.50 |
| 3x8 | 62.11 | 86.85 | 74.48 | 53.33 | 44.50 | 48.92 |
| 3x9 | 83.16 | 66.31 | 74.73 | 52.10 | 42.47 | 47.28 |
| 3x10 | 75.53 | 73.05 | 74.29 | 53.00 | 43.73 | 48.37 |
| 4x5 | 64.76 | 70.63 | 67.69 | 53.50 | 41.60 | 47.55 |
| 4x6 | 64.14 | 63.27 | 63.70 | 54.73 | 47.33 | 51.03 |
| 4x7 | 61.36 | 64.70 | 63.03 | 51.70 | 44.37 | 48.03 |
| 4x8 | 74.51 | 52.46 | 63.49 | 52.73 | 46.67 | 49.70 |
| 4x9 | 74.55 | 72.28 | 73.41 | 51.93 | 45.53 | 48.73 |
| 4x10 | 75.80 | 61.82 | 68.81 | 51.43 | 47.57 | 49.50 |
| 5x6 | 61.48 | 73.32 | 67.40 | 54.40 | 47.40 | 50.90 |
| 5x7 | 63.79 | 68.33 | 66.06 | 53.17 | 45.07 | 49.12 |
| 5x8 | 67.02 | 67.26 | 67.14 | 50.10 | 44.20 | 47.15 |
| 5x9 | 56.74 | 71.50 | 64.12 | 53.73 | 39.47 | 46.60 |
| 5x10 | 79.40 | 77.15 | 78.27 | 54.23 | 48.13 | 51.18 |
| 6x7 | 86.22 | 71.46 | 78.84 | 52.57 | 49.10 | 50.83 |
| 6x8 | 79.09 | 63.17 | 71.13 | 54.27 | 46.23 | 50.25 |
| 6x9 | 81.87 | 71.38 | 76.63 | 54.03 | 41.13 | 47.58 |
| 6x10 | 78.03 | 70.98 | 74.51 | 55.43 | 42.63 | 49.03 |
| 7x8 | 72.60 | 83.82 | 78.21 | 51.37 | 45.03 | 48.20 |
| 7x9 | 71.14 | 84.10 | 77.62 | 54.10 | 44.97 | 49.53 |
| 7x10 | 72.70 | 73.09 | 72.89 | 55.77 | 41.93 | 48.85 |
| 8x9 | 76.39 | 75.36 | 75.88 | 53.53 | 44.13 | 48.83 |
| 8x10 | 66.53 | 73.28 | 69.91 | 56.60 | 49.13 | 52.87 |
| 9x10 | 56.81 | 71.70 | 64.26 | 52.47 | 47.77 | 50.12 |
|  |  |  |  |  |  |  |
| LSD 5% | 3.80 | 3.17 | 3.50 | 3.46 | 4.01 | 3.75 |
|  |  |  |  |  |  |  |
| LSD 1% | 4.98 | 4.15 | 4.59 | 4.54 | 5.26 | 4.91 |

L1 and L2 refer to Rassidr location and Moshtohor location respectivel

**General combining ability effects (ĝi):**

Estimates of ĝi effects for individual parental genotypes for each treat in both and cross locations are presented in Table 6.General combining ability effects estimated herein were found to differ significantly from zero. The obtained high positive values for all traits in question except leaf angle would be useful from the breeder's point of view.

The parental P1(Gemiza 11)had significant positive ĝi effect for flag leaf area in both locations as well as combined analysis while R.W.C in first location (R.S)and the cross location for R.W.C and significant negative ĝi effect for relative water content and significant negative ĝi effect for leaf angle ,However ,it gave undesirable ĝi effects for other cases.

The parental P2(Shandwel 1) exhibited significant positive ĝi effects for flag leaf area ,peduncle leaf and relative water content in both and cross locations and total chlorophyll in the first location ,indicating that (Shandwel 1)could be considered as a good combiner for this trails. However, it gave undesirable ĝi effect for other cases.

The parental P3(G 168) showed significant positive ĝi effects for flag leaf area in the second location (Moshtoher) and the combined analysis and it poor combiner for other traits.

The parental P4(Sakha 93) show significant positive ĝi effects for peduncle leaf of the first location (R.S) and the combined analysis and RWC in first location. While ,it gave undesirable (ĝi) effect for other cases.

The parental P5(Gemiza 12) considered best combiner for flag leaf area in both and cross locations and peduncle leaf at the second location .However, it gave undesirable(ĝi) effect for other location.

The parental P6 (Misr 1) and p7  (L 125) were considered the best combiner for flag leaf angle in both and cross locations.Therefore , this parent could be considered a good combiner for flag leaf angle of wheat .

The parental P8 (L 137) exhibited significant positive (ĝi) effect for RWC and total chlorophyll in the second location .Meanwhile, it gave undesirable (ĝi) effect for other cases.

The parental P9 (Bulk37\_8) showed significant desirable (ĝi) effect for flag leaf area and flag leaf angle in both and cross locations RWC and total chlorophyll in the second location .Meanwhile, it gave insignificant (ĝi) effect for other cases.

The Parental variety P10 ( Bread43) expressed significant positive (ĝi) for peduncle leaf in both and cross locations RWC and total chlorophyll in the second location .This parent was consider a good combiner for this case . Such results are in harmony with those obtained by **Yildirim and Bahar (2010)**

**Table 6.** General combining effects for flag leaf angle and flag leaf area and peduncle leaf RWC and Total chlorophyll at both and cross locations.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **parent** | **Flag leaf angle(°)** | | | **Flag leaf area** **(cm2)** | | | **Peduncle leaf** **(cm2)** | | | **Relative water content** | | | **Total chlorophyll** | | |
| **L1** | **L2** | **Comb** | **L1** | **L2** | **Comb** | **L1** | **L2** | **Comb** | **L1** | **L2** | **Comb** | **L1** | **L2** | **Comb** |
| **g1 (Gemiza 11)** | 0.68\* | -1.69\*\* | -0.50 | -3.68\*\* | -4.20\*\* | -3.94\*\* | -1.99\*\* | -2.06\*\* | -2.02\*\* | 3.16\*\* | -0.72\* | 1.22\*\* | 0.33 | 0.40 | 0.36 |
| **g2 (Shandwel1)** | 1.17\*\* | 0.46 | 0.82\*\* | 5.20\*\* | 4.94\*\* | 5.07\*\* | 1.13\*\* | 0.63\* | 0.88\*\* | 4.51\*\* | 0.98\*\* | 2.75\*\* | 1.10\*\* | -1.74\*\* | -0.32 |
| **g3(G 168)** | 0.94\*\* | 0.94\*\* | 0.94\*\* | 0.24 | 0.96\*\* | 0.60\* | 0.11 | -0.26 | -0.07 | 1.10\*\* | 0.37 | 0.74\* | -0.72\* | -0.02 | -0.37 |
| **g4 (Sakha 93)** | 0.51 | -0.36 | 0.07 | -0.42 | -0.17 | -0.30 | 0.70\*\* | 0.48 | 0.59\* | 1.22\*\* | -4.29\*\* | -1.54\*\* | -1.73\*\* | -0.63 | -1.18\*\* |
| **g5 ( Gemiza 12)** | -0.50 | -0.03 | -0.26 | 2.05\*\* | 1.21\*\* | 1.63\*\* | 0.10 | 0.72\* | 0.41 | -3.46\*\* | -1.63\*\* | -2.55\*\* | -0.92\*\* | -0.14 | -0.53 |
| **g6 ( Misr 1)** | -1.56\*\* | 1.05\*\* | -0.26 | -1.63\*\* | -1.32\*\* | -1.47\*\* | -0.13 | -0.62\* | -0.38 | -0.66 | 0.27 | -0.19 | 1.34\*\* | 0.58 | 0.96\*\* |
| **g7 (L125)** | -1.46\*\* | -0.56\* | -1.01\*\* | -1.15\*\* | -1.16\*\* | -1.15\*\* | -0.18 | -0.61\* | -0.40 | -2.13\*\* | -0.35 | -1.24\*\* | 0.49 | 0.30 | 0.40 |
| **g8 (L137)** | 1.52\*\* | 1.35\*\* | 1.43\*\* | -0.59\* | -0.52 | -0.56 | -0.50 | -0.41 | -0.45 | 0.67 | 1.99\*\* | 1.33\*\* | 0.08 | 1.16\*\* | 0.62 |
| **g9 ( Bulk37\_8)** | -0.78\* | -1.28\*\* | -1.03\*\* | 1.20\*\* | 1.69\*\* | 1.44\*\* | 0.21 | 0.65\* | 0.43 | -1.29\*\* | 2.41\*\* | 0.56 | -0.41 | -0.81\* | -0.61 |
| **g10 ( Bread43)** | -0.53 | 0.11 | -0.21 | -1.21\*\* | -1.43\*\* | -1.32\*\* | 0.55\* | 1.47\*\* | 1.01\*\* | -3.11\*\* | 0.97\*\* | -1.07\*\* | 0.44 | 0.89\* | 0.66 |
| **L.S.D gi 0.05** | 0.63 | 0.55 | 0.59 | 0.53 | 0.62 | 0.57 | 0.50 | 0.60 | 0.55 | 0.74 | 0.62 | 0.68 | 0.67 | 0.78 | 0.73 |
| **L.S.D gi 0.0** | 0.82 | 0.72 | 0.77 | 0.69 | 0.82 | 0.75 | 0.66 | 0.80 | 0.73 | 0.97 | 0.81 | 0.89 | 0.89 | 1.03 | 0.95 |
| **L.S.D gi-gj 0.05** | 0.93 | 0.82 | 0.87 | 0.79 | 0.93 | 0.86 | 0.75 | 0.90 | 0.82 | 1.10 | 0.92 | 1.01 | 1.00 | 1.16 | 1.08 |
| **L.S.D gi-gj 0.01** | 1.23 | 1.08 | 1.15 | 1.04 | 1.22 | 1.12 | 0.98 | 1.19 | 1.08 | 1.45 | 1.21 | 1.32 | 1.32 | 1.53 | 1.42 |

\*,\*\* L1 and L2 refer to, significant at 0.5 , 0.01 levels of probability, Rassidr location and Moshtohor, respectively

**Specific combining ability effects (**ŝij**):**

Specific combining ability analysis of the parental combination were combated for all trail at both locations and combined , and are presented in Table (7)

For flag leaf angle, elven, elven and elven crosses exhibited significant negative ŝij effects at first location (Rassidr), second location (Moshtohor) and the combined analysis, respectively. The rest of crosses gave significant positive or insignificant ŝij effects. Eric of leaf ,if found in wheat is favorable and intensive production .The highest value was obtained by crosses P3 x P4.

Conceiting flag leaf area; fourteen, sixteen and sixteen crosses exhibited significant positive ŝij effects leaf area at first location (Rassidr), second location (Moshtohor) and the combined analysis, respectively. However, the most desirable ŝij for leaf area were detected for the cross P3 x P10 in both locations and combined analysis .

For peduncle leaf eight; six and six crosses expressed significant and positive ŝij effects in at first location (Rassidr), second location (Moshtohor) and the combined analaysis, respectively.. However, the best ŝij effects for peduncle leaf were detected for the crosses P7 x P8 at both and cross locations .

Regarding relative water content, nineteen, seventeen and eighteen crosses exhibited significant and positive ŝij in the first location (Rassidr), second location (Moshtohor) and the combined analysis, respectively. However, the cross P6 x P7 gave the best ŝij effects for this trait in the first location . Whereas, the cross P1 x P4 gave the best ŝij effects for this trait at the second location and the cross P1 x P10 in combined analysis .

For total chlorophyll three, six, and three crosses expressed significant and positive ŝij effects at first location (Rassidr), second location (Moshtohor) and the combined analysis, respectively. However, the best ŝij effects for this trail were detected for the crosses P1 x P7 in the first location while, the cross P2 x P5 in the second location and combined analysis.Such results are in harmony with those obtained by **El-Hosary *et al.*(2012)**

**Table 7.** Specific combining ability effects of, flag leaf angle and flag leaf area peduncle leaf Relative Water Content, total chlorophyll and at both and cross at both and cross

| **Crosses** | **Flag leaf area angle(°)** | | | **Flag leaf area (cm2)** | | **Peduncle leaf (cm2)** | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **L1** | **L2** | **Comb.** | **L1** | **L2** | **L1** | **L2** | **Comb.** |
| P1xP2 | -0.87 | 4.43\*\* | 1.78 | -3.63\*\* | -5.00\*\* | 0.92 | -1.54 | -0.31 |
| P1xP3 | 1.52 | 1.58 | 1.55 | 1.07 | -0.38 | 1.33 | 1.07 | 1.20 |
| P1xP4 | 3.68\*\* | 1.42 | 2.55\* | 0.99 | 0.46 | -0.99 | -2.53\* | -1.76 |
| P1xP5 | 3.97\*\* | -5.85\*\* | -0.94 | 0.31 | 0.86 | -0.39 | -2.03 | -1.21 |
| P1xP6 | 2.86\*\* | 3.86\*\* | 3.36\*\* | -7.91\*\* | -5.09\*\* | -0.60 | -0.76 | -0.68 |
| P1xP7 | -6.74\*\* | -6.65\*\* | -6.70\*\* | -5.89\*\* | -7.15\*\* | -0.61 | 0.13 | -0.24 |
| P1xP8 | 0.45 | 4.01\*\* | 2.23\* | -7.52\*\* | -9.46\*\* | 0.04 | 0.03 | 0.03 |
| P1xP9 | -6.12\*\* | -3.30\*\* | -4.71\*\* | 2.77\*\* | 2.58\* | -2.03\* | -1.73 | -1.88\* |
| P1xP10 | 0.50 | -0.29 | 0.10 | 6.58\*\* | 6.55\*\* | -0.74 | 3.15\*\* | 1.21 |
| P2xP3 | 2.20\* | 1.83 | 2.02\* | 1.43 | -0.88 | -0.52 | -0.51 | -0.51 |
| P2xP4 | 1.46 | 2.14\* | 1.80 | 3.70\*\* | 5.88\*\* | -1.11 | -0.05 | -0.58 |
| P2xP5 | 1.64 | 2.37\* | 2.00\* | 1.48 | 2.21\* | 2.82\*\* | 2.22\* | 2.52\*\* |
| P2xP6 | 4.81\*\* | -1.41 | 1.70 | 5.67\*\* | 7.93\*\* | 2.26\*\* | 2.82\*\* | 2.54\*\* |
| P2xP7 | 0.27 | 2.33\* | 1.30 | 6.58\*\* | 2.94\*\* | -1.06 | -1.22 | -1.14 |
| P2xP8 | -3.87\*\* | -5.17\*\* | -4.52\*\* | 2.64\*\* | 6.28\*\* | -0.48 | -1.02 | -0.75 |
| P2xP9 | -0.08 | -4.62\*\* | -2.35\* | 0.45 | -0.61 | 0.88 | 1.18 | 1.03 |
| P2xP10 | -1.83 | 2.33\* | 0.25 | -5.88\*\* | -6.19\*\* | -0.96 | 1.03 | 0.04 |
| P3xP4 | -9.14\*\* | -6.91\*\* | -8.03\*\* | -2.85\*\* | -2.47\* | -0.43 | -2.66\* | -1.55 |
| P3xP5 | 3.71\*\* | 2.31\* | 3.01\*\* | -2.09\* | -0.16 | -0.66 | 0.20 | -0.23 |
| P3xP6 | -6.73\*\* | -4.29\*\* | -5.51\*\* | -1.03 | -4.68\*\* | -1.03 | -0.56 | -0.79 |
| P3xP7 | 4.83\*\* | 1.28 | 3.06\*\* | -2.45\*\* | 0.98 | 3.29\*\* | -0.03 | 1.63 |
| P3xP8 | -0.64 | 0.61 | -0.02 | 0.76 | 1.57 | -1.06 | 0.13 | -0.47 |
| P3xP9 | -2.18\* | 0.43 | -0.87 | 2.01\* | 2.85\*\* | 0.06 | -0.70 | -0.32 |
| P3xP10 | 3.57\*\* | 1.14 | 2.36\* | 8.63\*\* | 10.80\*\* | -2.31\*\* | -3.75\*\* | -3.03\*\* |
| P4xP5 | -6.87\*\* | 1.39 | -2.74\*\* | -2.05\* | -4.28\*\* | 1.08 | 1.26 | 1.17 |
| P4xP6 | 3.67\*\* | -0.69 | 1.49 | 0.44 | 1.40 | -0.48 | 0.00 | -0.24 |
| P4xP7 | 0.93 | 1.36 | 1.14 | -6.79\*\* | -5.65\*\* | -1.97\* | -0.17 | -1.07 |
| P4xP8 | -1.55 | -3.52\*\* | -2.53\* | 7.72\*\* | 4.93\*\* | 3.85\*\* | 3.49\*\* | 3.67\*\* |
| P4xP9 | 4.42\*\* | 4.04\*\* | 4.23\*\* | 1.05 | 4.47\*\* | 1.81\* | 2.23\* | 2.02\* |
| P4xP10 | -1.84 | -2.68\*\* | -2.26\* | 2.20\* | 1.84 | -0.03 | 1.18 | 0.57 |
| P5xP6 | 1.38 | 2.74\*\* | 2.06\* | 6.42\*\* | 4.09\*\* | 0.92 | -0.21 | 0.36 |
| P5xP7 | 2.14\* | 5.05\*\* | 3.59\*\* | -3.96\*\* | -5.00\*\* | 0.50 | -0.74 | -0.12 |
| P5xP8 | -1.04 | -0.26 | -0.65 | 1.49 | 3.51\*\* | -0.29 | 1.42 | 0.57 |
| P5xP9 | -3.74\*\* | -6.87\*\* | -5.30\*\* | -1.29 | -2.26\* | -0.43 | 0.96 | 0.27 |
| P5xP10 | -0.16 | 2.34\* | 1.09 | -2.68\*\* | 1.83 | -1.23 | -0.19 | -0.71 |
| P6xP7 | 5.84\*\* | -0.59 | 2.62\*\* | 1.14 | 1.90 | -0.73 | -0.81 | -0.77 |
| P6xP8 | 2.53\* | -0.40 | 1.07 | -1.14 | -4.40\*\* | 0.52 | -0.08 | 0.22 |
| P6xP9 | -4.31\*\* | 1.76 | -1.27 | 4.91\*\* | 3.61\*\* | 1.11 | 1.09 | 1.10 |
| P6xP10 | -2.92\*\* | -1.20 | -2.06\* | -9.79\*\* | -9.32\*\* | 2.47\*\* | 0.71 | 1.59 |
| P7xP8 | 4.09\*\* | 0.38 | 2.23\* | 4.42\*\* | 5.71\*\* | 4.53\*\* | 3.92\*\* | 4.23\*\* |
| P7xP9 | 3.89\*\* | 0.17 | 2.03\* | -3.10\*\* | -0.99 | -2.81\*\* | -1.47 | -2.14\* |
| P7xP10 | -5.70\*\* | -9.22\*\* | -7.46\*\* | 8.31\*\* | 6.98\*\* | 1.35 | 2.61\* | 1.98\* |
| P8xP9 | 0.24 | 1.99\* | 1.12 | -1.65 | -2.03 | -3.49\*\* | -2.11\* | -2.80\*\* |
| P8xP10 | -0.51 | 1.94\* | 0.72 | -2.36\*\* | -3.12\*\* | -1.50 | -3.20\*\* | -2.35\* |
| P9xP10 | 2.79\*\* | 4.23\*\* | 3.51\*\* | -3.76\*\* | -3.64\*\* | -2.04\* | -3.56\*\* | -2.80\*\* |
| **LSD5%(sij)** | 2.11 | 1.85 | 1.96 | 1.78 | 2.09 | 1.69 | 2.03 | 1.85 |
| **LSD1%(sij)** | 2.77 | 2.43 | 2.59 | 2.34 | 2.75 | 2.22 | 2.67 | 2.44 |
| **LSD5%(sij-sikl)** | 3.10 | 2.72 | 2.89 | 2.61 | 3.07 | 2.48 | 2.99 | 2.72 |
| **LSD1%(sij-sikl)** | 4.07 | 3.57 | 3.80 | 3.43 | 4.04 | 3.27 | 3.93 | 3.59 |
| **LSD5%(sij-skil)** | 2.95 | 2.59 | 2.75 | 2.49 | 2.93 | 2.37 | 2.85 | 2.59 |
| **LSD1%(sij-skil)** | 3.88 | 3.41 | 3.63 | 3.27 | 3.85 | 3.11 | 3.75 | 3.42 |

\*,\*\* L1 and L2 refer to, significant at 0.5 , 0.01 levels of probability, Rassidr location and Moshtohor, respectively

**Table (7): Cont.**

| **Crosses** | **Relative water content** | | | **Total chlorophyll** | | |
| --- | --- | --- | --- | --- | --- | --- |
| **L1** | **L2** | **Comb.** | **L1** | **L2** | **Comb.** |
| P1xP2 | -6.42\*\* | -8.45\*\* | -7.44\*\* | 1.08 | -2.13 | -0.53 |
| P1xP3 | 4.65\*\* | 12.10\*\* | 8.37\*\* | -2.47\* | 0.42 | -1.02 |
| P1xP4 | -3.91\*\* | 16.74\*\* | 6.41\*\* | -6.02\*\* | -2.84\* | -4.43\*\* |
| P1xP5 | 14.30\*\* | -12.83\*\* | 0.73 | -0.23 | 3.14\* | 1.45 |
| P1xP6 | -6.45\*\* | -4.72\*\* | -5.58\*\* | 0.97 | 2.28 | 1.63 |
| P1xP7 | -14.66\*\* | -4.81\*\* | -9.74\*\* | 3.42\*\* | 1.83 | 2.63\* |
| P1xP8 | 0.35 | -1.35 | -0.50 | -2.39\* | 6.17\*\* | 1.89 |
| P1xP9 | -9.27\*\* | 9.46\*\* | 0.10 | 0.96 | 1.94 | 1.45 |
| P1xP10 | 12.50\*\* | 9.49\*\* | 11.00\*\* | -0.23 | 1.05 | 0.41 |
| P2xP3 | 6.45\*\* | 13.54\*\* | 9.99\*\* | 0.89 | 2.35 | 1.62 |
| P2xP4 | 6.31\*\* | 4.14\*\* | 5.22\*\* | 0.20 | -1.77 | -0.78 |
| P2xP5 | 4.09\*\* | -8.37\*\* | -2.14 | 0.16 | 6.41\*\* | 3.28\*\* |
| P2xP6 | -1.64 | -4.95\*\* | -3.30\*\* | -0.34 | -1.62 | -0.98 |
| P2xP7 | -8.00\*\* | -4.12\*\* | -6.06\*\* | -1.48 | -1.83 | -1.66 |
| P2xP8 | 0.86 | 0.19 | 0.52 | -0.44 | 0.87 | 0.22 |
| P2xP9 | 1.23 | 7.55\*\* | 4.39\*\* | 0.72 | -1.62 | -0.45 |
| P2xP10 | 4.03\*\* | 2.22\* | 3.13\*\* | -0.40 | -0.59 | -0.50 |
| P3xP4 | -1.17 | -5.10\*\* | -3.14\*\* | 0.79 | 2.25 | 1.52 |
| P3xP5 | -2.47 | -3.06\*\* | -2.76\* | 2.04 | -0.71 | 0.67 |
| P3xP6 | -7.31\*\* | 12.00\*\* | 2.35\* | -0.29 | 3.00\* | 1.36 |
| P3xP7 | -4.14\*\* | -23.10\*\* | -13.62\*\* | -0.77 | -2.52 | -1.64 |
| P3xP8 | -11.47\*\* | 13.45\*\* | 0.99 | 0.75 | -1.65 | -0.45 |
| P3xP9 | 11.53\*\* | -7.50\*\* | 2.02 | 0.00 | -1.70 | -0.85 |
| P3xP10 | 5.72\*\* | 0.68 | 3.20\*\* | 0.05 | -2.13 | -1.04 |
| P4xP5 | -4.82\*\* | 5.52\*\* | 0.35 | 2.92\* | -2.63\* | 0.15 |
| P4xP6 | -8.23\*\* | -3.74\*\* | -5.99\*\* | 1.89 | 2.38 | 2.14 |
| P4xP7 | -9.54\*\* | -1.69 | -5.61\*\* | -0.29 | -0.31 | -0.30 |
| P4xP8 | 0.81 | -16.27\*\* | -7.73\*\* | 1.16 | 1.13 | 1.15 |
| P4xP9 | 2.81\* | 3.14\*\* | 2.97\* | 0.85 | 1.97 | 1.41 |
| P4xP10 | 5.87\*\* | -5.88\*\* | -0.01 | -0.51 | 2.31 | 0.90 |
| P5xP6 | -6.21\*\* | 3.65\*\* | -1.28 | 0.75 | 1.95 | 1.35 |
| P5xP7 | -2.43 | -0.71 | -1.57 | 0.37 | -0.10 | 0.14 |
| P5xP8 | -2.00 | -4.13\*\* | -3.07\*\* | -2.28\* | -1.83 | -2.05 |
| P5xP9 | -10.33\*\* | -0.30 | -5.32\*\* | 1.84 | -4.58\*\* | -1.37 |
| P5xP10 | 14.15\*\* | 6.78\*\* | 10.47\*\* | 1.48 | 2.38 | 1.93 |
| P6xP7 | 17.20\*\* | 0.51 | 8.85\*\* | -2.49\* | 3.21\* | 0.36 |
| P6xP8 | 7.27\*\* | -10.13\*\* | -1.43 | -0.38 | -0.52 | -0.45 |
| P6xP9 | 12.01\*\* | -2.33\* | 4.84\*\* | -0.13 | -3.64\*\* | -1.88 |
| P6xP10 | 9.99\*\* | -1.29 | 4.35\*\* | 0.42 | -3.84\*\* | -1.71 |
| P7xP8 | 2.24 | 11.15\*\* | 6.70\*\* | -2.43\* | -1.43 | -1.93 |
| P7xP9 | 2.75\* | 11.02\*\* | 6.88\*\* | 0.79 | 0.47 | 0.63 |
| P7xP10 | 6.12\*\* | 1.44 | 3.78\*\* | 1.61 | -4.26\*\* | -1.32 |
| P8xP9 | 5.20\*\* | -0.07 | 2.57\* | 0.64 | -1.22 | -0.29 |
| P8xP10 | -2.84\* | -0.71 | -1.78 | 2.86\* | 2.08 | 2.47\* |
| P9xP10 | -10.60\*\* | -2.70\* | -6.65\*\* | -0.79 | 2.69\* | 0.95 |
| **LSD5%(sij)** | 2.49 | 2.07 | 2.27 | 2.27 | 2.62 | 2.43 |
| **LSD1%(sij)** | 3.27 | 2.73 | 2.99 | 2.98 | 3.45 | 3.20 |
| **LSD5%(sij-sikl)** | 3.66 | 3.05 | 3.33 | 3.33 | 3.86 | 3.57 |
| **LSD1%(sij-sikl)** | 4.81 | 4.01 | 4.39 | 4.38 | 5.07 | 4.70 |
| **LSD5%(sij-skil)** | 3.49 | 2.91 | 3.18 | 3.18 | 3.68 | 3.40 |
| **LSD1%(sij-skil)** | 4.58 | 3.82 | 4.19 | 4.18 | 4.83 | 4.48 |

\*, \*\* L1 and L2 refer to, significant at 0.5, 0.01 levels of probability, Rassidr location and Moshtohor, respectively

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**تحليل القدرة على التالف في التهجين التبادلي (10x10) للقمح النامي تحت الظروف الطبيعية والاجهاد المحلى لبعض صفات النمو المور فولوجيه و الفسيولوجية**

وفاء على محمد , محمود الزعبلاوى البدوى, و عدلى محمد مرسي و احمد على الحصرى

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تم التهجين بنظام النصف دياليل 10x10 في موسم 2018/2019 ، تم تقييم كل من الاباء و 45هجين (نواتج التهجين) تحت موقعين (رأس سدر ومشتهر) خلال موسم 2019/2020 لبعض الصفات الفسيولوجية. كان متوسط التباين للتراكيب الوراثية وتقسيمها (الهجن ،الاباء, والاباء مقابل الهجن) وايضا كلا من القدرة على الجمع بين عالية المعنوية لجميع الصفات المدروسة تحت ظروف الإجهاد الملحي و البيئة العادية وعبر الموقع. بينما ، كانت التفاعل بين كل من التراكيب الوراثية و الهجن و الاباءمع المواقع معنوية لجميع الصفات باستثناء المسافه بين ورقه العلم و السنبلة. كان التفاعل بين كل من القدرة العامة و الخاصة و المواقع معنويا لجميع الصفات المدروسة. كانت النسبة بين القدرة العامه / القدرة الخاصه أكثر من واحد لجميع الصفات باستثناء زاوية ورقة العلم تحت ظروف الإجهاد الملحي والظروف الطبيعية والتحليل التجميعى ومحتوى الماء النسبي تحت ظروف مشتهر و التحليل التجميعى. أظهر الاب الثانى شندويل 1اعلى تأثير إيجابي للقدرة العامه على التالف لمنطقة بين ورقة العلم و السنبلة والمحتوى المائي النسبي في كل من الموقعين بالإضافة إلى التحليل التجميعي وإجمالي الكلوروفيل في الموقع الأول ، مما يشير إلى أنه يمكن اعتبار الصنف شندويل 1 له قدرة عامه عالية لهذه الصفات كانت أكثر التفاعلات المرغوبة بين الأليلات وداخلها بواسطة P3 x P4 لزاوية ورقة العلم ، P3 x P10 للمنطقه بين ورقة العلم و السنبلة؛ P7 x P8 لمساحه ورقه العلم ؛ P1 x P10 للمحتوى الماء النسبي ؛ P2 x P5 لإجمالي الكلوروفيل واعطت تللك الهجن تأثيرات إيجابية كبيره للقدرة الخاصة على التالف.